CAIT
Center for Advanced Infrastructure & Transportation
Rutgers, The State University of New Jersey

QUARTERLY PROGRESS REPORT

Project Title:	Investigation into Modified Asphalt Binders for Improved Pavement Performance
RFP NUMBER:	NJDOT RESEARCH PROJECT MANAGER: Mr. Anthony Chmiel
TASK ORDER NUMBER/Study Number: Task Order No. 80 / 4-23908	PRINCIPAL INVESTIGATOR: Dr. Ali Maher
Study Start Date: 02/01/2000 Study End Date: 01/31/2003	Period Covered: 1st Quarter 2003

Task	% of Total	% of Task this quarter	% of Task to date	% of Total Complete
Literature Search	10%	50%	100%	10%
1. Material Collection	5%	25%	100%	5%
2. Laboratory Testing	50%	20%	100%	50%
3. Calibration	15%	10%	90%	13.5%
4. Reporting	20%	35%	85%	17%
Final Report				
TOTAL	100%			95.5%

1. Progress this quarter by task:
   - A. All samples were Long Term Oven Aged (LTOA) to determine if the addition of any of the admixtures might increase the potential for age hardening. Samples are currently being tested for stiffness (Frequency Sweep at Constant Height) and also for creep properties (Simple Shear at Constant Height). The final results will be compared to the Short Term Oven Aged (STOA) properties statistically to determine how the materials harden during aging. Limits will be set for admixture age hardening based on the baseline binder aging (PG64-22 and the two PG76-22).
   - B. Statistically analysis have been completed for all STOA testing. Some of the findings from the statistical analysis are:
     1. A statistical analysis was conducted using a Student's t-test analysis (two sample assuming equal variances). The analysis was utilized to determine if the samples were statistically equal or statistically not equal among the common test results and parameters. A 95 percent confidence interval was chosen for the analysis.
     2. The statistical analysis of the APA testing indicated that the 2 PG76-22 binders were statistically Not Equal (Koch Materials performed better than the Citgo). The Creanova Vestoplast was statistically Equal to the PG64-22 baseline binder (no increase in performance). The Eastman EE-2 and HTI Carbon Black were found to be statistically Not Equal to the PG64-22 or either of the two PG76-22's. The HTI Carbon Black performed worse than the PG64-22, while the Eastman EE-2 performed better than the PG64-22 but not as good as the two PG76-22's.
     3. The statistical analysis of the RSCH testing indicated that the permanent shear strain from 3,000 loading cycles followed the identical statistical trend as the 5,000 loading cycles. Therefore, for evaluation of the effect of modified binders, the RSCH can be run to 3,000 loading cycles instead of 5,000. The S-slope, the slope of the permanent shear strain vs loading cycles, was statistically determined to be significantly equal between the PG64-22 baseline binder and all of the asphalt modifiers (Creanova's Vestoplast, Eastman EE-2, and Hydrocarbon Technology's Carbon Black). This means that the accumulation of permanent shear strain during the RSCH test was the same (i.e no improvement in performance). The

two PG76-22 polymer-modified binders were shown to be significantly equal, indicating that both of the PG76-22 performs in a similar manner. However, none of the other mixes were classified to be statistically equal to the two PG76-22 mixes.

4. The statistical analysis of the FSCH testing indicated that all of the modifiers were statistically Not Equal to the PG64-22 (all modifiers increased the fatigue properties). The best performing material was the Citgo PG76-22, with the Koch Materials PG76-22 found to be statistically Not Equal to the Citgo PG76-22. This is due to the Koch Materials not performing as well as the Citgo PG76-22. The importance of this finding is that even though the performance grades of the two PG76-22 binders are the same, the fatigue performance was not equal. The combination of lower stiffness and variability of stiffness for the same material at higher caused a scattered result (no trend) from the statistical analysis.
5. The two PG76-22 polymer modified binders were determined to be statistically Equal when evaluating the maximum shear strain. The Creanova's Vestoplast and HTI Carbon Black was found to be statistically Not Equal to the PG64-22. This was due to the Creanova's Vestoplast performing better than the PG64-22 and the HTI Carbon Black performing worse. The Eastman EE-2 was found to be statistically Equal to the PG64-22. None of the admixtures were found to be statistically Equal to the PG76-22 materials. The statistical results of the creep slope were identical to the statistical results of the maximum shear strain. The two PG76-22 polymer modified binders were determined to be statistically Equal when evaluating the permanent shear strain. The Eastman EE-2 and Creanova's Vestoplast were found to be statistically Equal, however, neither material was found to be Equal to the PG76-22 materials. Therefore, both the Eastman EE-2 and Creanova's Vestoplast increased the shear strain creep performance from the baseline PG64-22, however, the increase was not enough to be comparable to the PG76-22 materials. The HTI Carbon Black was found to be Not Equal to the PG64-22 as the performance of the material was worse than the PG64-22.

2. Proposed activities for next quarter by task:
   A. Complete the stiffness and creep evaluation of the LTOA samples. The results will be compared to the STOA based on true performance, as well as a statistical approach.

3. List of deliverables provided in this quarter by task (product date)
   N.A.

4. Progress on Implementation and Training Activities
   N.A.

5. Problems/Proposed Solutions
   N.A.

6. Budget Summary*

Total Project Budget(# of years)	3 Years	$213,544.00
Total Project Expenditure to date		$212,765
% of Total Project Budget Expended		99%
Task Order Number/Study Number:		80 / 4-23908
Current Task Order Budget (# of years)	Years 1, 2, and 3	$213,544.00
Actual Expenditure to date against current task order		$212,765
% of current task order budget expended		99%

* These are approximate expended amounts for the project; these estimates are for reference only and should not be used for official accounting purposes. For a more accurate project accounting please review the quarterly invoice for this project.